We claim:

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1. A process of PECVD deposition of metal films comprising the steps of:
providing an ion promoting atmosphere; and
contacting a substrate with a plasma of approximately 50 to 90 % of a metal-containing gas in said ion promoting atmosphere at a pressure and temperature range sufficient for effective film deposition for said metal.

2. The process of claim 1 wherein said step of providing an ion promoting atmosphere comprises selecting said ion atmosphere from a group consisting of nitrogen gas, argon gas, neon gas, krypton gas, xenon gas, helium gas and radon gas.

3. The process of claim 1 wherein said step of contacting a substrate with a plasma comprises having a temperature range of approximately 150 to 500 degrees Celsius.

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4. The process of claim 1 wherein said step of contacting a substrate with a plasma comprises having a pressure range of 1 mtorr to 10 torr.

5. A process for PECVD deposition of a material on a substrate in a chemical vapor deposition (CVD) reaction chamber comprising:
locating said substrate in said reaction chamber;
placing said reaction chamber under vacuum pressure;
combining a precursor deposition gas containing said material and a chemically inert reactive species producer gas;
introducing said precursor deposition gas and said chemically inert reactive species producer gas into said reaction chamber; and
generating a plasma from said precursor deposition gas and said chemically inert reactive species producer gas in said reaction chamber.

6. A process for PECVD deposition of a metal film on a substrate in a chamber, comprising:

placing said chamber under vacuum pressure;

introducing a metal precursor deposition gas and a chemically inert ion producer gas into said chamber, wherein said chemically inert ion producer gas is selected from a group consisting of nitrogen gas, argon gas, neon gas, krypton gas, xenon gas, helium gas and radon gas;

generating a plasma in said chamber; and

depositing a layer of metal on said substrate surface.

7. The process of claim 6 wherein said step of introducing a metal precursor deposition gas and a chemically inert ion producer gas into said chamber comprises:

introducing said metal precursor deposition gas into said chamber in a range of approximately 10 to 50 sccm; and

introducing said chemically inert ion producer into said chamber at a rate of at least 4,000 sccm.

8. The process of claim 6 wherein said step of generating a plasma comprises generating a high density plasma.

9. A process for PECVD deposition of a metal film on a substrate in a chemical vapor deposition (CVD) reaction chamber comprising:

placing said reaction chamber under vacuum pressure;

bubbling a chemically inert reactive species producer gas through a metal precursor deposition liquid;

introducing said gas into said reaction chamber after said bubbling step;

generating a plasma in said reaction chamber; and

depositing a layer of metal on said substrate.

10. A method of forming a metal layer on a semiconductor wafer by plasma enhanced chemical vapor deposition, the method comprising the steps of:

forming a plasma, wherein said plasma contains at least a metal precursor deposition gas and a chemically inert collider gas; and

exposing said wafer to said plasma.

11. The method of claim 10 further comprising a step of forming said plasma and exposing said wafer to said plasma.

12. The method of claim 10 further comprising a step of forming said metal precursor deposition gas contained in said plasma by bubbling said chemically inert collider gas through a metal precursor deposition liquid.

13. A method of making a semiconductor device, comprising the steps of:

forming a product in a PECVD chamber through an interaction of a chemically inert charged species producer gas and a metal-containing compound in a plasma; and

exposing a substrate to said product for a period sufficient to form a metal layer on at least a portion of said substrate.

14. The method in claim 13, wherein said step of forming a product comprises forming a product free of constituents of said chemically inert charged species producer gas.

15. The method in claim 14, wherein said step of exposing a substrate to said product further comprises exposing a substrate to said product for a period sufficient to form a metal layer free of constituents of said chemically inert charged species producer gas.

16. The method in claim 15, wherein said step of forming a product further comprises forming a metal-containing ion of said metal-containing compound.

17. The method in claim 16, wherein said step of forming a product further comprises forming a metal-free ion from said metal-containing compound.

18. The method in claim 17, further comprising a step of introducing a reactant gas to said metal-containing ion; and wherein said step of exposing a substrate to said product comprises exposing said substrate to said product and to said reactant gas.

19. A process for PECVD deposition of a metal-containing film on a semiconductor wafer comprising the steps of:

heating said wafer in a PECVD process chamber to a temperature;

maintaining said temperature during said deposition of said metal-containing film;

maintaining a pressure in said process chamber during said deposition of said metal-containing film;

maintaining said wafer in an atmosphere of a gaseous mixture of ionized reactants formed from a metal-containing compound gas and a chemically inert reaction rate promoter gas; and

initiating and maintaining plasma enhanced chemical vapor deposition from said gaseous mixture.

20. The process of claim 19 further comprising a step of bubbling said chemically inert reaction rate promoter gas through a metal-containing compound precursor liquid.

21. The process of claim 19 wherein maintaining said temperature during said deposition of said metal-containing film comprises maintaining said temperature in a temperature range between approximately 150 to 500 degrees Celsius.

22. A method of performing a back-end-of-the-line process, comprising:

providing a semiconductor device under fabrication;

placing said device in a vacuum chamber;

supplying a metal source gas and a chemically inert-excitation gas within said vacuum chamber; and

interacting said metal source gas and said chemically inert-excitation gas.

23. The method in claim 22, wherein said step of interacting comprises igniting a plasma.

24. A method of making a semiconductor device using PECVD comprising:

providing a semiconductor device under fabrication;

placing said device in a vacuum chamber;

forming combined gasses comprising a metal source gas with a chemically inert energy-transfer gas;

supplying said combined gases to said vacuum chamber; and

igniting a plasma.

25. The method in claim 24, wherein said step of igniting a plasma comprises interacting said combined gases.

26. The method in claim 25, wherein said step of interacting said combined gases comprises producing a charged species.

27. A chemical vapor deposition method of providing a conformal titanium-containing layer of on a semiconductor wafer within a PECVD reactor, the method comprising the following steps:

injecting gaseous $TiCl_4$ and a chemically inert reactive species producer gas within said reactor; and

maintaining said reactor at a pressure and a temperature which are effective for

interacting said $TiCl_4$ and said chemically inert reactive species producer gas to deposit a titanium containing film on said wafer.

28. A semiconductor processing method comprising the following steps:

providing a semiconductor wafer;

subjecting said wafer to PECVD conditions in a chamber;

forming an ionized reactant species by interacting a metal source material with a chemically inert collider gas in said chamber; and

forming a metal-containing layer on said wafer from said ionized reactant species.

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29. A process for PECVD deposition of metal-containing films on a surface, the process comprising:

maintaining a pressure and a temperature which are effective for PECVD metal-containing film deposition; and

contacting said surface with a plasma of approximately 50 to 90% metal-containing compound in a chemically inert atmosphere.

30. A method for PECVD deposition of metal films comprising:

providing a metal-containing precursor gas configured to form an ionized reactant species in cooperation with a chemically inert reactive species producer gas;

adding said metal-containing precursor gas to said chemically inert reactive species producer gas;

forming a plasma containing said metal-containing precursor gas and said chemically inert reactive species producer gas;

exposing a substrate in a PECVD chamber to said ionized reactant species.

31. The method of claim 30 wherein said step of providing a metal-containing precursor gas comprises providing a gas wherein a metal in said gas is selected from a

group consisting of aluminum, copper, aluminum-copper alloys, tin, titanium, lead, titanium nitrides, titanium-tungsten alloys, tungsten, and tungsten-lead alloys.

32. A process for PECVD deposition of a titanium film on a surface, comprising the steps of:

housing said surface within a chamber;

establishing a temperature within said chamber;

establishing a pressure of approximately 5 Torr in said process chamber;

introducing a $TiCl_4$ gas into said chamber with a flow rate of approximately 30 sccm;

introducing an argon gas into said chamber, generally simultaneously with said step of introducing a $TiCl_4$ gas, at a flow rate of approximately 5,000 sccm;

introducing a hydrogen gas into said chamber, generally simultaneously with said step of introducing an argon gas, at a flow rate of approximately 10,000 sccm;

producing a generally uniform titanium coating on said surface.

33. The process of claim 32 wherein said producing step comprises establishing plasma enhanced chemical vapor deposition from said $TiCl_4$ gas and said hydrogen gas.

34. The process of claim 33 wherein said producing step further comprises applying a plasma-creating energy sufficiently proximate to said surface for deposition of said titanium coating.

35. A method of providing a chemical vapor deposition environment, the method comprising:

introducing a deposition gas to a chamber; and

introducing an inert gas to said chamber.

36. The method of claim 35 further comprising a step of forming a plasma comprising said deposition gas and said inert gas.

37. An atmosphere for a chemical vapor deposition process, comprising:

a deposition gas having a pressure contribution and a chemical reactability; and

a chemically inert gas mixed with said deposition gas, limiting said pressure contribution of said deposition gas, and increasing said chemical reactability of said deposition gas.

38. The atmosphere of claim 37 wherein said deposition gas is a film precursor deposition gas.

39. The atmosphere of claim 37 wherein said deposition gas is a metal film precursor deposition gas.

40. A plasma, comprising:

a reactive species of a precursor gas; and

a reactive species of an inert reaction promoting gas intermixed with said precursor gas.

41. The plasma in claim 40, further comprising a reactive species of a reactant gas, wherein said collider gas represents a volume of at least 4 10 of a volume represented by said reactant gas.

42. A method of supporting a reaction between a precursor gas and a reactive gas, comprising:

introducing a chemically inert reaction-promoter gas to said precursor gas; and

ionizing said reaction-promoter gas.

43. The method in claim 42, further comprising a step of forming a reactive species of a constituent of said precursor gas with an ion from said reaction-promoter gas.

44. The method in claim 43, wherein:

said step of introducing a chemically inert reaction-promoter gas comprises introducing said chemically inert reaction-promoter gas to a precursor gas comprising $TiCl_4$; and

said step of forming a reactive species comprises forming $TiCl_3^+$.

45. The method in claim 43, wherein

said step of introducing a chemically inert reaction-promoter gas comprises introducing said chemically inert reaction-promoter gas to a precursor gas comprising $TiCl_3^+$; and

said step of forming a reactive species comprises forming $TiCl_2^{++}$ from said $TiCl_3^+$.

46. A method of encouraging a formation of a reactive species of a gas, comprising:

providing a chemically non-reactive ionization agent;

ionizing said agent; and

allowing a collision between an ion of said agent and a constituent of said gas.

47. The method in claim 46, wherein said step of providing a chemically non-reactive ionization agent comprises providing an agent that is chemically non-reactive with respect to said gas.

48. The method in claim 46, wherein said step of providing a chemically non-reactive ionization agent comprises providing an agent that is generally chemically non-reactive.

49. The method in claim 48, wherein said step of providing a chemically non-reactive ionization agent comprises providing an inert gas.

50. The method in claim 49, wherein said step of providing a chemically non-reactive ionization agent comprises providing a noble gas.

51. A method of advancing a reaction between a first constituent of a first gas and a second constituent of a second gas, wherein said first gas and said second gas contribute to a total pressure within a chamber, and said method comprising:

contributing to said total pressure with a third gas; and

collidingly fostering said reaction using said third gas.

52. The method in claim 51, wherein said step of collidingly fostering said reaction comprises:

creating a reactive species of said first constituent using said third gas; and

allowing said reactive species to chemically interact with said second gas.

53. The method in claim 52, further comprising a step of allowing said reactive species to chemically interact with said third gas.

54. A method of aiding a reaction involving a metal-containing gas that provides a partial pressure contribution within a chamber, comprising:

limiting said partial pressure contribution of said metal-containing gas with an addition to said chamber of a selection from a group consisting of:

a generally inert gas,

a gas that is inert with respect to said reaction,

a chemically reactive gas, and

combinations thereof; and

encouraging a formation of an ion from said metal-containing gas using said selection.

55. A method of plasma etching a material, comprising:
providing a gas;
providing a charged species promoter;
ionizing said gas with RF energy;
ionizing said charged species promoter with RF energy;
ionizing said gas with said charged species promoter; and
allowing an ion from said gas to chemically react with said material.

56. A method of forming a film on a substrate, comprising:
sputtering a material from a target toward said substrate;
introducing a gas having a reactivity to said material; and
promoting said reactivity using an inert reaction fostering agent.

57. A method of chemically reacting a first gas and a material, comprising:
introducing an inert gas to said first gas;
generating a reactive species from said first gas;
generating a non-reactive species from said inert gas;
further generating a reactive species from said first gas using said non-reactive species; and
introducing said reactive species to said material.

58. The method in claim 57, wherein said step of introducing said reactive species to said material comprises introducing said reactive species to a material being sputtered.

59. The method in claim 57, wherein said step of introducing said reactive species to said material comprises introducing said reactive species to a material on a substrate.

60. The method in claim 59, wherein said step of introducing said reactive species to said material comprises introducing said reactive species to a reactive species of a second gas adsorbed onto said substrate.

61. A method of operating a PECVD system configured to operate in a first mode under a set of parameters and free of a reaction-promoter agent, said method comprising:

running a second mode of said PECVD system, comprising:

providing a precursor gas to a chamber;

providing a reactant gas to said chamber;

providing an inert reaction-promoter gas to said chamber;

generating a plasma from said precursor gas, said reactant gas, and said inert reaction-promoter gas;

contacting a substrate in said chamber with a precursor reactive species and a reactant reactive species;

forming a film on said substrate through a reaction of said precursor reactive species and said reactant reactive species, wherein said film has a uniformity, and wherein said reaction defines a reaction rate.

62. The method in claim 61, wherein said step of forming a film comprises forming a film under said set of parameters, wherein said film has a uniformity better than a uniformity in said first mode.

63. The method in claim 62, wherein said step of forming a film comprises forming a film having a uniformity of at most 5%.

64. The method in claim 61, wherein said step of forming a film on said substrate through a reaction comprises forming a film under said set of parameters, wherein said reaction defines a reaction rate greater than a reaction rate in said first mode.

65. The method in claim 64, wherein said step of forming a film on said substrate through a reaction comprises forming a film at a reaction rate ranging from about 4 to about 10 angstroms per second.

66. The method in claim 61, wherein said step of providing an inert reaction-promoter gas comprises establishing a percentage of said inert reaction-promoter gas to said reactant gas in said chamber of at least 40%.